Protocol for the Evaluation of the Proposed Performance Requirements for Instrument Marbling Evaluation

RESEARCH MANAGER:
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PARTICIPANTS IN THE STUDY:
Standardization Branch (STDZ)
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NCBA Instrument Grading Task Force

OBJECTIVES:
To determine the feasibility of the draft performance elements for establishing the accuracy and repeatability (if needed) in measuring the degree of marbling in beef carcasses using vision based instrument systems under normal beef carcass grading conditions.

STUDY DESIGN

STUDY PREREQUISITES
Data Collection: Following data collection, the technology provider or processor shall provide STDZ all data (actual and predicted values) from each carcass evaluated. After completion of the trials and submission of instrument data, STDZ will provide the expert degree of marbling data to the technology provider.

Exclusion of Data
In the ordinary course of operating vision grading instrumentation, some portion of the images taken in a plant setting will be faulty due to operator or software error. In normal operational procedures, these images are quality checked and excluded from use for determining a grade. In order for this study to provide the best results possible, data from such images should be excluded from the data set. For this reason, STDZ, through consultation with technology provider(s), may exclude data from selected carcasses for images that are not accurately obtained. Analysis of the images will be conducted to determine if operator error or image capture error can be determined. This data will also be recorded and analyzed.

Vision Based Instrument Systems: Each technology provider or processor shall provide trained camera operators/technicians to ensure optimum operation of each system. Each system shall undergo normal warm-up or start-up protocols and calibration routines before conducting the trial.

Sample Population: The sample population shall adequately represent the U.S. fed beef population and the full range of degrees of marbling shall also be represented. Repeatability will be estimated from carcasses representing full range of degrees of

marbling. The following degree of marbling matrix will serve as the template in guiding carcass selection over a three day period

Degree of Marbling	Number under Normal Grading Condition	Number for Repeatability
Traces or less	50	40
Slight	300	40
Small	300	40
Modest	200	40
Moderate	100	40
Slightly Abundant or higher	50	40
Total	1000	240

For computational purposes; the degree of marbling will be recorded as a marbling score. The marbling score is defined by:

Degree of Marbling	Marbling Score
Practically Devoid	100
Traces	200
Slight	300
Small	400
Modest	500
Moderate	600
Slightly Abundant	700
Moderately Abundant	800
Abundant	900

Carcass Selection: Two representatives from the NCBA Instrument Grading Task Force and/or STDZ will select carcasses. The carcass selection representatives should ensure that the distribution and coarseness of marbling does not influence the testing procedures. Of the carcasses selected, no more than 80% of the images shall derive from one side (left or right).

ESTABLISHING THE EXPERT DEGREE OF MARBLING

In order to validate the accuracy of an instrument, an *actual expert degree of marbling* must be established for each carcass that is measured. Degree of marbling must be evaluated by an expert panel of three representatives determined by STDZ. Before the start of the trial, the expert panel will utilize 10 carcasses to correlate with and prepare for the instrument trial. Each official will independently evaluate and record the degree of marbling for each exhibit in accordance with the Official United States Standards for Grades of Carcass Beef (January 1997). Degree of marbling shall be recorded to the nearest 10 percent of a degree.

The *Expert Degree of Marbling* for each exhibit will be calculated when all three independent observations are within 50 marbling score units of the average score, and the average of those observations will be the *actual expert degree of marbling* .

DEMONSTRATION OF THE ACCURACY OF DEGREE OF MARBLING PREDICTION AT LINE SPEEDS
Carcasses must be presented consecutively for image capture and analysis under normal beef carcass grading conditions (i.e., image capture of each carcass, moving at a minimum chain speed of 300 head/hour). Each carcass exhibit will be imaged by each technology provider (or processor) wishing to participate.

Image capture shall be done on line during the normal grading activity to ensure realistic approach to evaluation as current practices dictate. All carcasses being presented by the plant during carcass selection periods will be imaged by the technology providers and the carcass selectors will identify those to be included in the trial after all technology providers have captured images. The carcass selectors will communicate to the technology providers which side of the carcass images will be taken from for each period of image capture.

Carcasses shall be placed on a well lit stationary rail (re-grade or equivalent) for determination of *actual expert degree of marbling* as described above. This activity should be completed within 30 minutes of image capture.

Accuracy will be evaluated by comparing (correlation and regression) the degree of marbling output to the actual expert degree of marbling. The accuracy performance elements to estimate include:

- R^2;
- Slope
- Intercept

DEMONSTRATION OF THE REPEATABILITY OF DEGREE OF MARBLING PREDICTION
Data will be collected and analyzed by both the triple placement and triple trigger methods from the same carcasses. To accomplish this, selected carcasses representing the full range of marbling degrees will be presented to the technology image capture units and all images will be captured. The triple trigger method will be conducted first with the triple placement method being conducted immediately thereafter. Repeatability will be evaluated by determining how often all three predicted marbling scores fall within a (e.g., 20 marbling units) range of the mean of those three scores.

Triple Trigger: Properly place the camera head unit (with as much precision as possible) over the 12th-l3th rib interface of one side of each carcass, and obtain three sequential but separate images without moving the camera head unit. This activity will be performed on a stationary basis.

Triple Placement: Place the camera head unit (with as much precision as possible) over the 12th-l3th rib interface on one side of each carcass and obtain one image; remove the camera head unit; return the camera head unit to the ribeye interface and obtain a second image; remove the camera head unit again; return the camera head unit to the ribeye interface, and obtain a third image.

STATISTICAL ANALYSIS

Data shall be analyzed using the same Excel workbook formulas to establish if the requirements have been met. The data will also be analyzed to determine R^2, as well as the slope and intercept using the regressive procedures from a statistical software package (SAS, V9.1, 2005).